

Classifier Combination Schemes In Speech Impediment Therapy Systems

Dénes Paczolay, László Felföldi and András Kocsor

In the therapy of the hearing impaired one of the central problems is the handling of the lack of proper auditive feedback which impedes the development of intelligible speech. Our Phonological Awareness Teaching System, the "SpeechMaster" package, seeks to apply speech recognition technology to speech therapy [7, 8]. It provides a visual phonetic feedback for replacing the insufficient auditive feedback of the hearing impaired. We designed and implemented computer-aided training software that uses an effective phoneme recognizer and provides a real-time visual feedback in the form of flickering letters on calling pictures. The brightness of the letters is proportional to the speech recognizers output.

The effectiveness of the therapy relies heavily on accurate phoneme recognition. Phoneme recognition is a special pattern recognition problem [1, 2, 11] where the continuously varying speech signal has to be mapped to a symbol of a phoneme. Because of the environmental conditions, simple recognition algorithms may have a weak classification performance, so various techniques such as normalization and classifier combination are applied to increase the recognition accuracy.

Speaker normalization reduces the variance in the speech data of different speakers caused by their different vocal tract lengths. Vocal Tract Length Normalization techniques [3, 10] transform the speech data to the space of the "standard" speaker. This transformation is determined by a warp factor correlated with the speaker's vocal track length. In an earlier paper [9] we demonstrated how to estimate this warp factor in real-time.

Classifier combinations [6, 12] aggregate the results of many classifiers, overcoming the possible local weakness of the individual inducers, thus producing a more robust classification performance. In this paper the traditional (*Prod*, *Sum*, *Min*, *Max*, etc.) [5], linear (*simple*-, *weighted*-, and *AHP-based* [4] *averaging*), nonlinear (*kernel*) and stacked combination rules are examined.

From experimental tests we found that classifier combinations did prove effective in real-time speech recognition, fulfilling the special requirements of the task of therapy.

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